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FOOT-AND-MOUTH DISEASE.[1]

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NATURE AND CHARACTERISTICS.

Foot-and-mouth disease, also known as aphthous fever, epizootic aphtha, and eczema contagiosa, is an acute, highly communicable disease chiefly confined to cloven-footed animals and characterized by an eruption of vesicles or blisters on the mucous membrane of the mouth and on the skin between the toes and above the hoofs. The vesicles rupture, forming erosions and ulcerations; there are also salivation, tenderness of the affected parts, loss of appetite, lameness, emaciation, and diminution in the quantity of milk secreted.

The tremendous ravages of the disease are seen in the number and variety of the species attacked. While it may be regarded as essentially a disease of cattle, hogs would seem to be as easy a prey. Almost in the same grade of receptivity are sheep and goats. Next in order of susceptibility come the buffalo, American bison, camel, chamois, llama, giraffe, and antelope. Horses, dogs, cats, and even poultry may occasionally become infected with the disease, the last three being particularly dangerous as carriers of the contagion. Man himself is not immune, and the frequency of his infection by coming in contact with diseased animals is established by numerous observations.

As with other communicable diseases, the source and origin of foot-and-mouth disease have given rise to much speculation. The disease had been known in Europe for centuries, but it was not until comparatively recent years that the erroneous conceptions of its spontaneous origin as a result of climatic and meteorological conditions, exhausting journeys, etc., were abandoned. It is now conceded that foot-and-mouth disease is propagated by a specific virus and that every outbreak starts from some preexisting outbreak.

[1] This bulletin is largely a revision of the department's earlier publications on the subject. It is intended for general distribution.

Investigators have so far been unable to identify or isolate the specific organism causing the disease, although numerous attempts have been made to cultivate and stain it by laboratory methods. Experiments have shown that the virus will pass through standard germ-proof filters, thus indicating its minute size and the reason it has not been detected by the staining methods. The contagion may be found in the serum of the vesicles on the mouth, feet, and udder; in the saliva, milk, and various secretions and excretions; also in the blood during the rise of temperature.

A wide distribution of the virus and a rapid infection of a herd is the result. Animals may be infected directly, as by licking, and in calves by sucking, or indirectly by such things as infected manure, hay, utensils, drinking troughs, railway cars, animal markets, barnyards, and pastures. Human beings may carry the virus on their shoes and clothing and transmit it on their hands when milking, since the udder is occasionally the seat of the eruption. It may also be carried by dogs, cats, rats, chickens, pigeons, etc. Milk in a raw state may also transmit the disease to animals fed with it.

The observations made by some veterinarians would lead us to suppose that the virus is quite readily destroyed. It is claimed that stables thoroughly cleaned become safe after drying for a short time. Hence, litter of all kinds, such as manure or soiled hay and straw, may remain infective for a longer time because they do not dry out. Other authorities maintain that the virus is quite tenacious and may live in stables even so long as a year. They also state that animals which have passed through the disease may be a source of infection for several months after recovery.

Unlike most other infectious diseases, foot-and-mouth disease may attack the same animals repeatedly. No definite immunity is conferred by an attack.

The period of incubation (that is, the time elapsing between the exposure of an animal to infection and the development of the disease in that animal) is variable, usually from three to six days. The disease may appear in 24 hours, or, in exceptional cases, not for 18 days or even longer.

LOSSES.

The highly contagious character of foot-and-mouth disease and its rapid spread to practically all exposed susceptible animals lead to heavy losses. Since the mortality is comparatively low, ranging from only 3 per cent or less in mild forms to 30 or 40 per cent in malignant cases, the havoc caused by the pestilence is sometimes underestimated. But there are other sources of loss which are much more important than the actual mortality. The fever and the difficulty of eating cause a rapid and extreme loss in flesh and a lessening or cessation of the milk secretion. The udders often become inflamed and ruined by the formation of abscesses, and cows affected in this way are sometimes rendered permanently valueless for

milk production. The inflammation of the feet may cause the horn to drop from the toes, producing great lameness and lasting injury. Abortion is frequent with pregnant animals, and typical lesions have been observed in the newly born at birth. Altogether these losses may amount to 20 or 30 per cent of the value of affected animals.

In addition there are indirect losses of a commercial nature. Dairy farmers are put out of business for a time. Necessary quarantine restrictions greatly interfere with the movement of live stock and such commodities as hay, straw, hides, and farm produce. The business of the stockyards and slaughtering centers is greatly interfered with. Sometimes it is necessary to close stockyards for disinfection. The whole business of marketing, transporting, feeding, and slaughtering is interrupted and deranged. Losses of this character may reach enormous proportions.

THE DISEASE IN OTHER COUNTRIES.

Foot-and-mouth disease has prevailed in Europe for a great many years and has occasioned tremendous economic losses there.

In Italy, France, Switzerland, Germany, and Russia the plague has existed so long and has gained such a foothold that it is economically impossible to fight it with the American methods of slaughter and disinfection, for to do so would be to kill a large percentage of the live stock of those countries. In consequence, little or no progress toward eradication has been made by the authorities, though the severity of the disease in France appears to have abated somewhat in recent months.

The outbreak which appeared in Germany in 1888 increased steadily until 1892, when it diminished gradually for a few years, but the disease again reached great proportions in 1899. Thereafter it continued to exist to a greater or less extent until in 1911 it attained a virulence unequaled before. In that year 3,366,369 cattle, 1,602,927 sheep, 2,555,371 hogs, and 53,674 goats were affected. At that time the total number of cattle, sheep, swine, and goats in Germany was only 51,319,000, while there were in the United States 172,572,000, or between three and four times as many. It can readily be imagined, therefore, what it would mean to the United States if the disease were to gain the foothold here that it had in Germany, where, as these figures show, approximately one out of seven of the animals susceptible to the disease was affected.

The German Government, of course, has not left the disease to itself. It attempted to control recent outbreaks by the method of slaughter, but the pestilence had gained too much headway and was too firmly established in too many portions of the country for this method to succeed, and the slaughter of the infected herds had to be abandoned. It now appears that there is no hope of getting rid of it until the virus has worn itself out. As soon as the animals' period of acquired immunity is over and favorable conditions present themselves, the contagion breaks out with renewed virulence. It has been impossible to control it by means of quarantines. One

scientist has asserted that unless all the infected farms were absolutely isolated and the movement not only of live stock but of persons absolutely prohibited, the disease could not be stamped out. Such a quarantine is, of course, utterly impossible to enforce. In portions of Germany the farmers, realizing that the disease is inevitable, make haste to be done with it by exposing their stock deliberately to mild cases in the hope that this will result in an immediate mild attack and immunity for several years thereafter. Such immunity, however, is very uncertain.

Great Britain, Denmark, Norway, and Sweden, on account of their comparatively isolated positions, have been more successful in keeping out the disease. The outbreaks in these countries have been more sporadic, and by resorting to immediate slaughter the authorities have been able to stamp them out. Great Britain has applied both quarantine and slaughter for many years, and in an outbreak near Dublin in 1912 measures were adopted which were even more stringent than any that have been used in the United States. A British official (Cope) asserted in 1899 that after his country's experience with this disease it was "more dreaded by the farmers and stock raisers of Great Britain than cattle plague or pleuropneumonia, and they are now willing and ready to put up with any restrictions, of however drastic a character, considered necessary by the central department to stamp it out." The British authorities have succeeded in suppressing each outbreak, but reinfection often occurs from the neighboring continent. Great Britain has been reported as free of the disease for a few months up to the time this is written (March, 1915). Sweden is now reported as affected.

In November, 1906, the disease reached Belgium from France, where it was quite prevalent, and by the end of the year every Province in Belgium was affected, and the Netherlands as well. Efforts to eradicate it from Belgium were unavailing. The Netherlands apparently succeeded in stamping it out for about six months, but it has reappeared there.

The disease is also more or less prevalent in Austria-Hungary, Spain, and in the Balkan countries.

Australia and New Zealand have remained free from it.

We have less accurate information regarding Asia and Africa, but the disease is known to prevail in Japan and China and in the Philippine Islands, and it is doubtful if any considerable part of the Orient is free from it.

In South America it is reported as common in Brazil, Argentina, and Uruguay, and it probably exists in other countries.

Canada and Mexico are fortunately free from the disease.

OUTBREAKS IN THE UNITED STATES.

Foot-and-mouth disease has appeared in the United States on six different occasions—1870, 1880, 1884, 1902, 1908, and 1914.

An extensive outbreak in 1870 was introduced by way of Canada, where the infection was brought by an importation of cattle from Scotland. It spread into the New England States and New York and appears to have been arrested within a few months. Its failure to spread more extensively and its early disappearance have been ascribed to favorable conditions, such as the movement of live stock from west to east, the limited trading at that period as compared with the present time, the restriction of traffic by winter weather, and the infrequency of travel which obtained at that time among people.

About 1880 there were two or three lots of animals brought to the United States affected with this disease, but there was no extension from the animals originally affected.

In 1884 there was a small outbreak at Portland, Me., caused by imported cattle, and the disease spread to a few herds outside of the quarantine station. Owing to the small number of animals affected and the limited area of territory covered by the disease, it was easily controlled by the ordinary measures of quarantine and disinfection.

It will be observed that in all of these early outbreaks the contagion was introduced with imported animals. Since the development of a stringent system of inspection and quarantine of imported live stock no instance of that kind has occurred. On subsequent occasions the infection has evidently been brought in with contaminated products or materials and not by means of live animals.

In November, 1902, the disease was discovered in Massachusetts and Rhode Island. The earliest cases were traced to Chelsea, Mass., near the docks, and it was suspected for a time that the infection was brought in with foreign shipping, by some such means as hay, straw, halters, ropes, hides, hair, wool, etc. Later developments, however, and especially investigations into the cause of the 1908 outbreak, led to the belief that a more probable source of the infection was cowpox vaccine virus imported from a country where foot-and-mouth disease existed (probably Japan), the vaccine virus being contaminated with the virus of foot-and-mouth disease.

A Federal quarantine was declared by the Secretary of Agriculture on November 27, 1902, as soon as the nature of the disease was established, and steps for eradication were at once taken by the Bureau of Animal Industry of the United States Department of Agriculture in cooperation with authorities of the affected States. The methods followed consisted of inspection to trace and detect the disease, quarantine of infected premises and territory, slaughter and burial or burning of diseased and exposed animals, and disinfection of premises.

This outbreak involved Massachusetts, New Hampshire, Vermont. and Rhode Island. It was eradicated in about six months. There were found infected 244 herds including 4,712 cattle. Of these, 205 herds with 3,872 cattle, as well as 360 hogs and 220 sheep and goats, were slaughtered. The cattle infected but not slaughtered were those that either died or completely recovered before slaughtering

could be carried out. The animals slaughtered were valued at $184,155.10, and the Federal Government reimbursed owners to the extent of 70 per cent, or $178,908.57. It is understood that the States paid the remainder. The total cost to the Department of Agriculture of stamping out the disease was about $300,000.[1]

The next appearance of foot-and-mouth disease was early in November, 1908, when it was observed in cattle near Danville, Pa. A Federal quarantine was issued November 12. The infection was traced back to the stockyards at East Buffalo, N. Y., and to Detroit, Mich. The disease appeared in the States of Michigan, New York, Pennsylvania, and Maryland. A careful and thorough investigation

FIG. 1.—Cow affected with foot-and-mouth disease characterized by salivation and by lesions on teats and around coronet of right hind foot.

made by the writer in conjunction with Dr. M. J. Rosenau of the Public Health Service demonstrated that the outbreak started from calves used to propagate vaccine virus at an establishment near Detroit, and that the source of the infection was contaminated Japanese vaccine virus.[2]

Vigorous measures of eradication similar to those employed in 1902–3 were at once put into effect and the disease was stamped out

[1] A history of the outbreak of 1902–3 appears in the Nineteenth Annual Report of the Bureau of Animal Industry (for 1902), page 391.

[2] A report of this investigation was published as Bureau of Animal Industry Circular 147. A history of the 1908 outbreak was given in the Twenty-fifth Annual Report of the Bureau of Animal Industry (for that year), page 379. It may be remarked that the importation and the domestic manufacture of vaccines and other biological products are now under Government supervision, those intended for use in human medicine being looked after by the Public Health Service and those for veterinary use by the Bureau of Animal Industry.

in about five months at an expense to the Department of Agriculture of about $300,000 and to the States of about $113,000. The inspectors made 108,683 visits to farms, stockyards, etc., and inspected over a million and a half animals (including reinspections). One hundred and fifty-seven premises were found infected, and 3,636 animals (2,025 cattle, 1,329 hogs, and 282 sheep and goats), valued at $90,033.18, were slaughtered. Owners were reimbursed for the value of their animals and property destroyed, one-third being paid by the States and two-thirds by the Federal Government.

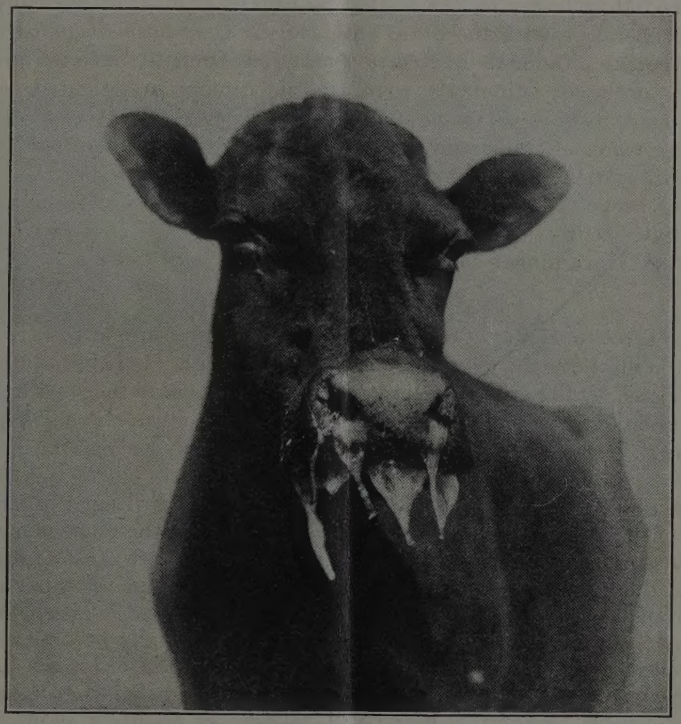

FIG. 2.—Head of cow affected with foot-and-mouth disease.

The latest invasion was discovered in the vicinity of Niles, Mich., in October, 1914, after it had evidently been underway since August of the same year. This is the most serious and extensive outbreak ever known in this country. At the time this is written (March, 1915), the disease has been found in 21 States and the District of Columbia, at places ranging from the Atlantic to the Pacific coasts. The work of eradication has not been completed at this writing, though it is well advanced and the epizootic seems to be under control. The affected States are Connecticut, Delaware, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Massachusetts, Michigan, Montana,

New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Virginia, Washington, West Virginia, and Wisconsin. Illinois has had the largest infected area and the largest number of animals affected. Next in order come Pennsylvania, Michigan, and Ohio. The Union Stock Yards at Chicago became infected and were a source of dissemination of the contagion north, east, south, and west. These and other yards found infected were closed temporarily and disinfected.

The first Federal quarantine was issued October 19, 1914. A campaign to check the spread of the disease and to stamp it out was immediately begun by the United States Department of Agriculture in cooperation with the State authorities. Quarantines against the movement of animals and certain materials from the infected areas were declared, shipments were traced, rumors investigated, and thorough inspections made in an effort to discover all infected stock. As measures of eradication, diseased herds are being slaughtered and buried and the premises disinfected. The owners of live stock and other property destroyed on account of the disease are reimbursed to the extent of the appraised value, half of which is paid by the Federal Government and half by the State.

SYMPTOMS.

In three to six days or even longer after the exposure of the animal to the infection the disease makes its appearance. It is usually first indicated by the animal suffering from a chill, quickly followed by an invasion of fever, which may cause the temperature to rise as high as 106° F. These symptoms are not always present, or may be in so slight a form as to escape notice. Following this in one or two days it will be noticed that small vesicles or blisters about the size of hemp seeds or a pea are making their appearance upon the mucous membranes of the mouth at the border and upper surface of the tongue near the tip, the inside of the cheeks, on the gums and the inner surface of the lips, or on the margin of the dental pad. These little blisters contain a yellowish watery fluid and gradually become more extensive as the disease advances. Soon after the eruptions have appeared in the mouth of the animal it will be noticed that there is considerable swelling, redness, and tenderness manifest about the feet, at the coronet and between the digits of each foot. Eruptions similar to those within the mouth make their appearance upon these swollen regions of the foot a day or two later, and at this stage it is usual to find that like lesions have made their appearance upon the perineum of the victim. In the case of milch cows, the udder, and more particularly the teats, show the same vesicular eruption, but the latter as the result of milking soon become covered with reddened spots deprived of the superficial layer of skin and may develop deep, obstinate fissures.

As soon as the disease has become well established the patient evinces pain when attempting to eat; in fact the appetite is often

so seriously affected that all food is refused and the animal uneasily opens and shuts its mouth with a characteristic smacking sound, while strings of cohesive, ropy saliva hang suspended from the lips. With the advance of the disease the vesicles have widened and extended until they may reach a diameter ranging from that of a dime to that of a silver dollar. These rupture soon after their appearance, sometimes on the first day, more rarely on the second or third day. After they have ruptured the grayish white membrane forming the blister may remain attached for a day or more, or disappear speedily and leave deeply reddened sensitive spots or erosions, both within the mouth and upon the coronet and between the claws of the feet. Similar erosions, which quickly form scabs as a rule, may

FIG. 3.—Blisters and scabs of foot-and-mouth disease on teats.

be noticed in cases in which the teats of milch cows have become affected, and instances are reported in which sloughing of the tegument immediately around the lesions upon the udder has occurred. Owing to the tough, fibrous nature of the bovine skin, it is exceedingly rare for sloughing to occur upon any part of the body other than those mentioned.

The attack upon the feet of an animal is frequently manifested in all four feet at once, but one or more of the feet may entirely escape and remain unaffected throughout the course of the disease. The ulceration of the interdigital tissue may extend to the ligaments of the fetlock or produce disease of the joint or bone. As the feet become sensitive and sore the animal lies down persistently, and it has been found that bed sores develop with amazing rapidity in all

such cases and wholly baffle all attempts at treatment until after the patient has regained its feet.

The disease may attack some of the internal organs before it appears upon any of the external tissues. These cases are very liable to prove quickly fatal. The animal dies from paralysis of the heart, due to the formation of poisonous principles within the system, or it may suffocate by reason of the action of these same poisons upon the tissues of the lungs, or it may choke to death as a result of paralysis of the throat.

In cases of serious affection of the udder the erosions will often be found located within the passages of the teats, resulting in a "caked" udder, and the same toxic poisoning which is the cause of death in the apoplectiform types just mentioned may arise from this source. In any event the milk from such cases will be found dangerous for use, causing fatal diarrhea in sucking calves or young pigs and serious illness in human consumers. The milk obtained from cows suffering with foot-and-mouth disease is not readily converted into either butter or cheese, but remains thick, slimy, and inert in spite of churning and attempts at curdling. Pregnant animals may abort. In pigs, sheep, and goats the lesions in the foot are most common, but both forms may be observed or only the mouth lesions.

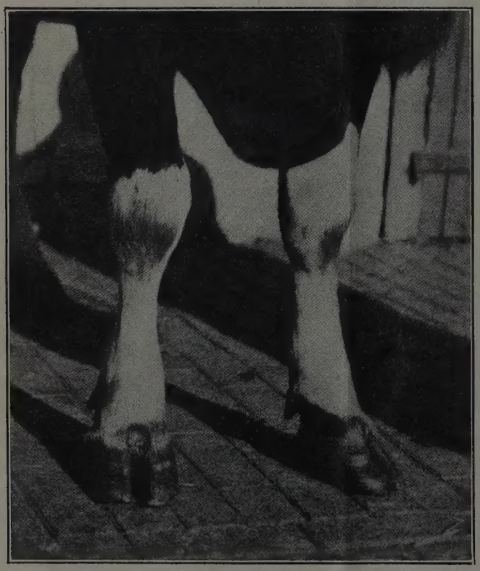

FIG. 4.—Lesions of foot-and-mouth disease on feet of cow.

When the disease has become fully established it will be found that the duration of the attack will vary greatly with different animals. From 10 to 20 days are usually required for the recovery of the normal appetite and spirits in mild outbreaks, while the return to a full flow of milk, in the case of milch cows, is seldom witnessed before the arrival of the following season.

In the malignant type of the disease it requires from three months to a year for an animal to recover. The mortality, as already stated, is usually low. The disease is more fatal in young animals that have been fed on infected milk, and produced death in from 60 to 80 per cent

of these cases as a result of gastro-enteritis. In the present outbreak numerous new centers of infection have been started among hogs and calves which were fed on unpasteurized infected milk from creameries.

DIAGNOSIS.

The recognition of this affection should not, as a rule, be difficult, especially when the disease is known to be in the vicinity; in fact, the group of symptoms form a clinical picture too decided to be doubted. The combination of high fever, vesicular inflammation of the mouth, and hot, painful, swollen condition of the feet, followed 24 to 48 hours later by the appearance of numerous blisters varying in size from that of a pea to that of a walnut on the udder and feet and in the mouth should prevent any serious or long-continued error in the diagnosis. However, in the inoculation of calves we have a certain and final test. In 24 to 96 hours after inoculation the calves present the characteristic blisters. Such inoculation should be practiced, however, only by officials who are properly authorized to deal with contagious diseases.

HOW TO DISTINGUISH FOOT-AND-MOUTH DISEASE FROM OTHER AFFECTIONS.

The lesions of no other disease of cattle closely simulate the vesicular eruption of foot-and-mouth disease on the lining membrane of the mouth. When the blisters have ruptured, however, and the resulting lesions have become contaminated by numerous secondary forms of microorganisms, the correct recognition of the disease may be involved in considerable difficulty.

Cowpox or horsepox may be accidentally transmitted by inoculation. But the eruption of the "pox" goes on to the development of a pustule, while in foot-and-mouth disease the eruption is never more than a vesicle, even though the contained fluid may become turbid. The inoculation test in the case of cowpox does not respond with fever and eruption for at least 10 days, and often longer.

Necrotic stomatitis (sore mouth due to a germ) may be distinguished from foot-and-mouth disease by the fact that in the latter disease there is a rapid infection of the entire herd, including the adult cattle, as well as the infection of hogs and sheep. The characteristic lesion of foot-and-mouth disease is the appearance of blisters containing a serous fluid upon the mucous membrane of the mouth and upon the udder, teats, and feet of the affected animals. In necrotic stomatitis blisters are never formed, destruction of the tissues occurring from the beginning and being followed by the formation of yellowish, cheesy patches principally found involving the lining membrane of the mouth, especially the tongue and cheeks.

In mycotic stomatitis (sore mouth due to a fungus or mold), portions of the lining membrane become inflamed and in a few days it changes to a croupous membrane which peels off, leaving a raw surface, while the thin skin between the toes may also be inflamed. The

previous history of the case; the failure of the blisters, if any appear, to spread extensively; the absence of vesicular eruptions on other portions of the body, notably the udder and teats, and, characteristically, the hoof, together with the absence of rapid spread to practically all cattle in the herd and the complete negative character of inoculation of calves, distinguishes between the local disease named and foot-and-mouth disease. Mycotic stomatitis occurs in only from 10 to 50 per cent of the animals in a herd, usually in the late summer or early fall after a dry spell, and it does not run a regular course.

The lesion, resulting from ergotism may be distinguished from those of foot-and-mouth disease by the lack of eruptions in the mouth and

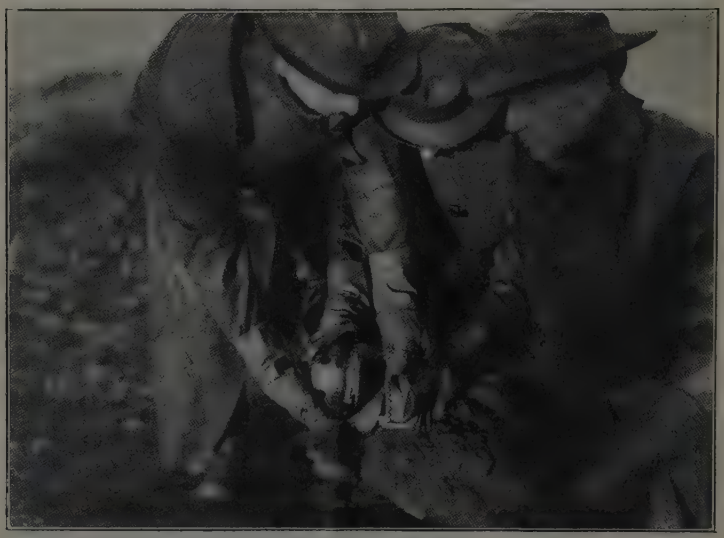

FIG. 5.—Inspectors examining cow for foot-and-mouth disease. They are equipped with rubber coats, gloves, boots, and hats, which are cleansed with disinfectants after each examination, in order to avoid spreading the contagion.

by the location of the disease at the tips of the ears, end of the tail, or upon the lower part of the legs, usually below the knees or hocks The lesion of ergotism does not take the form of pustules or blisters, but manifests itself first as a swelling about the ankle, which later may slough and circumscribe the limb, forming a deep crack, extending entirely around the limb and forming a distinct line of demarcation between the healthy skin above and the diseased below. The absence of ulcerous sores on the coronet and between the claws, together with the healthy condition of the membranes of the mouth and the knowledge that the lesion upon the limb in question extends uninterruptedly around it, should point conclusively to a diagnosis of ergotism and to the exclusion of all fears of foot-and-mouth disease.

In foul foot or ground itch of cattle, the inflammation of the skin and toes is general and not in certain spots, as in foot-and-mouth disease; the mouth remains unaffected and the presence of the disease may be traced to filth and poor drainage.

The severer forms of the disease might be confounded with certain general diseases. Where gastro-intestinal symptoms predominate acute gastric catarrh or inflammation of the intestines might be thought of. Involvement of the lungs might lead to a diagnosis of acute congestion of the lungs or pneumonia. The distinction is apparent in these diseases by the lack of vesicular eruption on the mucous membrane or skin, and also by lack of evidences of infection in the herd or neighboring animals.

PREVENTION AND ERADICATION.

The measures to be adopted to prevent the spread of the affection must take into consideration the highly infectious nature of the disease, its ease of dissemination, and the liability of the virus to live outside of the body of an animal for long periods. Great care should therefore be observed in keeping healthy animals unexposed to the contagion. When an outbreak occurs in a community, the owner should make every effort to keep other animals from coming in contact with his diseased cattle. This especially applies to dogs, cats, goats, and poultry, which usually have access to the stables and barnyards and in this way furnish excellent means for disseminating the infectious principle. He should be equally particular in prohibiting any person from coming onto his premises, especially an attendant or owner or other person in any way connected with cattle. Such a herd may be placed under quarantine, with an inspector appointed to keep the premises under constant surveillance.

This method of quarantine alone, while very satisfactory in many instances, is rather tardy in obtaining the desired result. The experience of European governments, already mentioned, shows that eradication by this method alone, when the disease has obtained a foothold, is practically impossible. For this reason when the disease breaks out in a country like the United States, where the contagion is likely to spread rapidly by means of infected cars, manure, hay, and other feed, and where the results of its obtaining a firm foothold would be so disastrous, it seems that this method of temporizing is rather tedious, and more radical steps are required in order to suppress and eradicate completely the infection in the quickest and most thorough manner possible.

It would therefore appear better to concentrate the expense incident to the extermination of foot-and-mouth disease by purchasing and slaughtering all affected and exposed cattle after judicious appraisement. The carcasses of these animals should be totally de-

stroyed, preferably by cremation, or otherwise by burying them in a hole 6 feet deep and covering them with air-slaked lime. The infected stable should be disinfected by thoroughly cleaning it, scrubbing the floor with hot water, brushing down all loose dust from the walls, and tearing off all woodwork which is partly decayed. Then the whole interior of the stable should be disinfected with one of the following substances:

A 5 per cent solution of pure carbolic acid.

Chlorid of lime, U. S. P. strength (30 per cent available chlorin), 1 pound to 3 gallons of water.

Formaldehyde, 1 quart 40 per cent solution to 5 gallons of water.

FIG. 6.—Method of slaughtering and burying cattle. The trench is deep enough to allow carcasses to be covered with at least 5 feet of dirt. Animals are led to trench and there killed, usually by shooting. Hides are slashed to prevent anyone from exhuming carcasses in order to get the hides, and carcasses are cut open and covered with quicklime.

A 3 per cent solution of cresol compound, U. S. P., or accepted substitute therefor, containing at least 50 per cent cresylic acid.

All stable utensils should be thoroughly cleaned and disinfected by the application of a solution of one of the above disinfectants. The manure should be burned or disinfected and spread over ground (other than meadow land) that is to be turned under. No other cattle should be purchased for at least sixty days after the complete disinfection of the premises.

The success in eradicating the disease by combined quarantine, slaughter, and disinfection, as practiced in the United States, Denmark, Great Britain, and a few other countries, demonstrates in a striking manner the efficacy of slaughtering and the futility of relying upon quarantine alone in stamping out the disease.

Inoculation has been adopted in some countries in order to have the disease spread quickly through the herds, and while this practice has undoubted value where the disease is indigenous, it is not desirable in this country and should not be adopted.

As a rule medical treatment with a view to curing affected animals is not to be recommended under conditions prevailing in the United States, where the disease has not become established, and the first object is to stamp it out as quickly as possible. Even though most animals would recover, with or without treatment, it would be practically impossible, while they were being held for recovery, to prevent the spread of the infection to others. The disease would be likely to spread faster than it could be cured. As already pointed out, it has been found impossible to prevent absolutely the spread of the contagion by the strictest quarantine alone, under the usual farm conditions. In addition, the affected animals that have passed through the disease may become a source of further infection as virus carriers for weeks and months after they have apparently recovered, and are susceptible of reinfection as one attack does not confer permanent immunity.

FOOT-AND-MOUTH DISEASE IN MAN.

Foot-and-mouth disease is primarily and principally a disease of cattle; secondarily and casually, a disease of man. It is transmissible to man through the eating or drinking of raw milk, buttermilk, butter, cheese, and whey from animals suffering from foot-and-mouth disease. It is also transmitted directly, though more rarely, from the salivary secretions or other infected material which may gain entrance through the mucous membrane of the mouth. It is doubtful whether the disease can be transmitted to man by cutaneous or subcutaneous inoculation, though it is probable that the infection may be communicated if the virus directly enters the blood through wounds of any kind. Children are not infrequently infected by drinking unboiled milk during the periods in which the disease is prevalent in the neighborhood, while persons in charge of diseased animals may become infected through contact with the diseased parts or by milking, slaughtering, or caring for the animals.

The symptoms in man resemble those observed in animals. There is fever, sometimes vomiting, painful swallowing, heat and dryness of the mouth, followed by an eruption of vesicles on the mucous membrane of the mouth, and very rarely by similar ones on the fingers. The vesicles appear on the lips, gums, cheek, and edge of the tongue, and are about the size of a pea. The vesicles soon rupture, leaving a small erosion which is soon covered by a thin crust under which the new formation of epithelium proceeds rapidly. The skin eruption mostly appears on the hands, tips of the fingers, base of the nails, and more seldom on the toes and other parts of the body. Besides these local changes, during the course of the disease there are occa-

sionally observed headache, pain in the limbs, vertigo, abdominal cramps, vomiting, diarrhea, and weakness. The disease is very seldom fatal, usually appearing in a very mild form except in weakened children, in whom an accompanying intestinal catarrh may lead to a fatal termination.

Veterinarians who have had considerable experience with the disease among animals regard the human affection as by no means uncommon in countries where foot-and-mouth disease prevails, but the disturbance of health is usually too slight to come to the notice of the family physician.

But few outbreaks of the disease have occurred in the United States, and therefore cases of its transmission to man in this country are quite rare. Dr. James Law reports having observed the disease in man

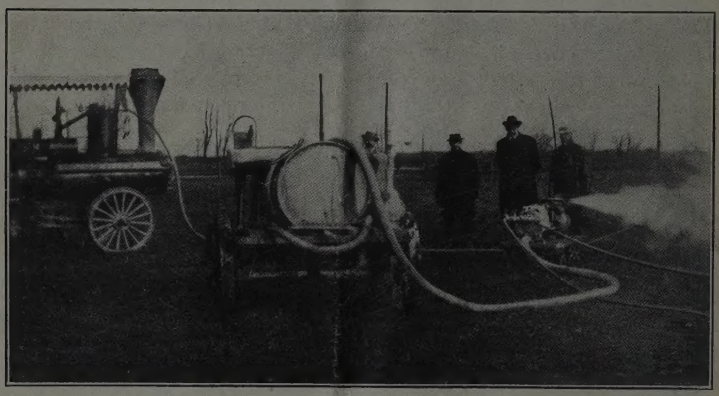

FIG. 7.—Outfit for disinfecting on a large scale. The tank contains 5 per cent chlorinated lime solution, which is sprayed by a steam pump, steam being supplied by a traction engine.

from drinking infected milk during the epizootic of 1870 in the Eastern States, but the outbreaks of 1880 and 1884 affected such a small number of animals and were so quickly suppressed that no instance of its transmission to man was recorded. A few cases have been reported by Brush accompanying the New England outbreak of 1902. Similar reports have been likewise received concerning the appearance of vesicular eruptions in the mouths of children during the 1908 and 1914 outbreaks, and the history of these cases incriminates the milk supply.

Experiments by Loeffler and Froesch, as well as recent experiments which have been made in Denmark and Germany, indicate that the infection is comparatively easy to destroy by heat or the usual antiseptics. Milk pasteurized at a temperature of 60° C. for 20 minutes is safe so far as infection by foot-and-mouth disease is concerned.

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